Title: Enhancements to DRDC Toronto's HFE-Guide for the World-Wide-Web
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Date: July 31, 2002
Document No.: DRDC Toronto CR 2002-121
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Report No.: AIM (AC227, July, 2002)

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Document No.: DRDC TORONTO CR 2002-121
Date: July 31, 2002
Report No.: AIM (AC227, July, 2002)

Enhancements to DRDC Toronto's HFE-Guide for the World-Wide-Web

- Final Report -

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Abstract

Two key standards of HFE-Guide (MIL-HDBK-46855; MIL-STD-1472) were upgraded. Data Item Descriptions (DIDs), Issue B, taken from an Annex in MIL-HDBK-46855A, replaced earlier versions of DIDs. Six Allied Naval Engineering Publications (ANEPs) were typed and scanned from hardcopies and then added as a new section of HFE-Guide.

The locations of search results are now identified, including both the standard in which the result is found and its location within that standard. A newly designed history mechanism now keeps track of cross references so as to avoid repeated presentations, which formerly "trapped" users in infinitely repeating cycles. Another addition allows users to provide feedback about any aspect of the Guide at any point during a session. Notes, warnings and disclaimers were updated and instances of the name, "Defence and Civil Institute of Environmental Medicine (DCIEM)" were changed to reflect recent changes in the names of Canada's Defence Research Laboratories.

Possible future work includes the addition of new standards and materials, the creation of a broader context for cross-referenced material, selectable references within the content windows, provisions for downloadable and enhanced PDF versions of the standards, intelligent links among various standards and the ability to print portions of the standards material.

Résumé

Deux normes clés du Guide HFE (MIL-HDBK-46855 et MIL-STD-1472) ont été mises à jour. Des descriptions d'éléments de données (DED), version B, provenant d'une Annexe de MIL-HDBK-46855A, remplacent des versions précédentes de DED. Six publications interalliées sur l'ingénierie navale (ANEP) ont été dactylographiées. Elles ont ensuite été numérisées à partir de la copie papier, puis insérées dans le Guide HFE dans lequel elles constituent une nouvelle section.

Les résultats des recherches sont désormais référencés. La norme dans laquelle le résultat a été trouvé ainsi que le paragraphe en question de cette norme sont indiqués. Un mécanisme nouvellement conçu permet de recouper les références, afin d'éviter les répétitions qui, jusqu'alors, piégeaient les utilisateurs dans des cycles répétitifs sans fin. Un nouveau système permet aux utilisateurs de faire des commentaires sur n'importe quel aspect du Guide, à tout moment au cours d'une séance de recherche. Les remarques, les avertissements et les clauses de non-responsabilité ont été mis à jour et les occurrences de l'entité « Institut de médecine environnementale pour la défense (IMED) » ont été remplacées afin de refléter les récentes modifications apportées aux noms des Laboratoires de recherches pour la défenses du Canada.

Parmi les travaux qui pourraient être réalisés, on compte : addition de nouvelles normes et de nouveau matériel; création d'un champ plus vaste de matériel référencé; références pouvant être sélectionnées à partir des fenêtres de contenu; possibilité d'accès à des versions téléchargeables des normes en format PDF amélioré; liens intelligents entre diverses normes; et capacité d'imprimer une partie du contenu des normes.

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Executive Summary

HFE-Guide was upgraded through the addition of more recent versions of two key standards: MIL-HDBK-46855A and MIL-STD-1472F, replacing MIL-HDBK-46855 and MIL-STD-1472D, respectively. Sources of the recent versions were copies in PDF and MS Word form, respectively. Extraction of the text material was straightforward but a programme was written to automate the process of extracting the figures from the PDF document.

Data Item Descriptions (DIDs), Issue B, taken from an Annex in MIL-HDBK-46855A, replaced earlier versions of DIDs. The latter are accessible from the main window along with other general standards.

PDF-formatted documents have some advantages but the existing ones available for these more recent versions of the standards often have not incorporated a clickable bookmark list, table of contents and index, which considerably reduces their utility for users. Future consideration should be given to providing enhanced PDF versions for all standards in the Guide.

Other material added to HFE-Guide included six Allied Naval Engineering Publications (ANEPs). Only hardcopies of that material were available, which meant that the standards had to be typed and scanned before adding them to the Guide. Some of the figures were of such complexity and so reduced in size that some of the information they contained was unreadable. The rule-of-thumb adopted in reproducing material from all of the ANEPs was that if an item could not be read, it would be scanned. That meant some sacrifice in legibility but eliminated any danger of including material that might be incorrect.

In the previous version of HFE-Guide, users could initiate a search for terms or phrases within selected standards and would be taken to a special page showing a list of results along with their associated content topics. Unfortunately, neither the standard in which a result appeared nor its contextual location within that standard were provided to users. Search results are now identified in terms of both the standard in which they are found and their location within that standard.

Cross-references occur throughout the standards and a list of them appears in a special panel below the content panel of the main window. A newly designed history mechanism now keeps track of cross-references so as to avoid repeated presentations that a user has already seen. Formerly, users could be led into infinitely repeating cycles of cross-referenced material.

An enhancement to HFE-Guide interface now allows users to provide feedback about any aspect of the Guide at any point during a session. That information can then be made available to the Scientific Authority and to developers of the Guide to support future enhancements.

Notes, warnings and disclaimers have been updated in a special Disclaimer section of the Guide and on the windows of individual standards as appropriate.

Instances of the name, "Defence and Civil Institute of Environmental Medicine" and the associated acronym, "DCIEM" have been changed to "Defence R&D Canada - Toronto" and "DRDC Toronto," respectively, to reflect recent changes in the names of all of Canada's Defence Research Laboratories.

Possible future work that would add to the Guide's usefulness includes the addition of new standards and materials and the creation of a broader context for cross-referenced material. Regarding the latter, methods should be explored for how to inform users of their locations as they hyperlink to more and more cross-references from a given content area. Users need feedback to help monitor where they are in a descending exploration of cross-referenced material including notification of when they have ascended back to the top level of that content area. Such feedback is particularly important since items in the table of contents panel are only selectable at those top level content areas. Additionally, users should be given a quick way to ascend back to the top level without having to repeatedly click the "Back" button.

Another useful addition to the Guide would be support for clickable references within content windows. That would permit those windows to serve a function similar to that of browser pages, taking the user to new locations, most often within the same window.

Consideration should be given to making downloadable and enhanced PDF versions of standards available to the Guide's users. The advantage here is the added value of the Guide to users who might like to have locally available copies of one or more of the standards. A disadvantage that should be considered is whether providing copies would reduce the use of the Guide. A compromise might provide copies of standards with accompanying comments about the advantages of using the Guide.

A detailed description was given for how "intelligent links" might be designed and implemented for several standards. This example could be further extended to provide support for other kinds of integration with HFE-Guide. Simple agents in the form of "cookies" already are available with the Guide. Cookies monitor the state of the Guide for individual users and restore the last state when an individual leaves and then returns to the Guide.

More sophisticated agent support should be considered. For example, a software tool called, *LOCATE*, a workspace layout design tool, currently has agents that search the Guide for information that might help *LOCATE* users. Although the *LOCATE* agents know about and search the Guide, agents linked directly to the Guide could disseminate information about the existence of the Guide and its content to prospective users.

Finally, a print facility would be useful for printing out selected content of standards. Consideration should be given to printing contextual information associated with that content and other related information, as appropriate, or as specified by the user.

Edwards, J. L. 2002. Enhancements to DRDC Toronto's HFE-Guide for the World Wide Web. AC227, DRDC Toronto CR 2000-121.

Sommaire

On a mis à jour le Guide HFE en y incorporant des versions plus récentes de deux normes clés, MIL-HDBK-46855A et MIL-STD-1472F, qui remplacent respectivement les normes MIL-HDBK-46855 et MIL-STD-1472D. Les sources des versions récentes ont été copiées respectivement en format PDF et MS Word. L'extraction du texte a été directe, mais on a dû élaborer un programme pour automatiser le processus d'extraction des figures du document en format PDF.

Des descriptions d'éléments de données (DED), version B, provenant d'une Annexe de la norme MIL-HDBK-46855A, remplacent des versions précédentes de DED. Ces dernières, ainsi que d'autres normes générales, sont accessibles à partir de la fenêtre principale.

Les documents en format PDF présentent certains avantages. Toutefois, les versions plus récentes de ces normes actuellement disponibles dans ce format ne comportent pas de liste cliquable de signets, de table des matières ou d'index, ce qui réduit considérablement leur possibilité d'utilisation. À l'avenir, il faudrait fournir des versions en format PDF amélioré de toutes les normes référencées dans le Guide.

Parmi d'autres éléments incorporés dans le Guide HFE, on compte six publications interalliées sur l'ingénierie navale (ANEP). Comme on ne disposait que de la copie papier de ces publications, il a fallu les retaper, puis les numériser avant de les incorporer dans le Guide. Certaines figures étaient si complexes et si petites qu'il n'a pas été possible de déchiffrer certains des renseignements qu'elles renfermaient. Tout ce qui ne pouvait être lu a été numérisé : c'est la règle générale que nous avons suivie pour reproduire le matériel tiré de toutes les publications ANEP. Nous perdions une certaine lisibilité en procédant ainsi, mais nous éliminions ainsi tout risque d'inclusion de matériel potentiellement erroné.

Dans la version précédente du Guide HFE, les utilisateurs pouvaient rechercher des termes ou des phrases contenus dans des normes bien précises. Une page spéciale donnant une liste des résultats ainsi que des sujets associés était alors affichée. Malheureusement, ni la norme dans laquelle le résultat de la recherche avait été trouvé, ni son emplacement contextuel dans cette norme n'étaient affichés. Désormais, les résultats des recherches ne sont identifiés qu'en termes de la norme dont ils sont tirés et de leur emplacement dans la norme en question.

Il y a des recoupements partout dans les normes. Une liste de ces recoupements est affiché dans un tableau spécial placé sous le tableau de contenu de la fenêtre principale. Un mécanisme nouvellement conçu permet de suivre les recoupements, afin d'éviter la répétition de présentations que l'utilisateur a déjà vues. Auparavant, les utilisateurs pouvaient se retrouver dans des cycles sans fin de matériel déjà présenté.

Une amélioration de l'interface du Guide HFE permet maintenant aux utilisateurs de faire des commentaires sur n'importe quel aspect du Guide, à tout

moment au cours d'une séance de recherche. L'autorité scientifique et les personnes ayant élaboré le Guide peuvent consulter cette information et s'en servir pour améliorer le Guide.

Les remarques, les avertissements et les clauses de non-responsabilité ont été mis à jour et inclus dans une section spéciale du Guide et dans les fenêtres correspondant aux normes individuelles, suivant les besoins.

Les occurrences de l'entité « Institut de médecine environnementale pour la défense » et de son acronyme « IMED » ont été remplacées respectivement par « Recherche et développement pour la défense Canada – Toronto » et « RDDC-Toronto », afin de refléter les modifications apportées récemment aux noms de tous les Laboratoires de recherches pour la défense du Canada.

Parmi les travaux futurs qui permettraient d'améliorer l'utilité du Guide, on compte l'addition de nouvelles normes et de nouveau matériel et la création d'un contexte plus vaste de matériel référencé. Pour ce qui est de la création d'un contexte plus vaste, il y aurait lieu d'envisager des manières d'informer les utilisateurs sur leur emplacement au fur et à mesure que des hyperliens leur donnent accès à de plus en plus de références dans un domaine donné. Les utilisateurs ont besoin de renseignements les aidant à suivre leur progression dans un matériel référencé, y compris une notification de leur retour au niveau premier dans ce domaine. De tels renseignements sont particulièrement importants, car les articles de la table des matières ne peuvent être choisis qu'à ce niveau premier du domaine. De plus, les utilisateurs devraient avoir la possibilité de revenir rapidement au niveau premier, sans avoir à cliquer à plusieurs reprises sur le bouton « Retour ».

La possibilité de cliquer sur des références dans des fenêtres de contenu serait un autre élément utile. On pourrait utiliser ces fenêtres un peu comme des pages de navigation et ainsi avoir accès à de nouveaux domaines, le plus souvent à partir de la même fenêtre.

Il faudrait envisager la possibilité de fournir aux utilisateurs du Guide des versions PDF téléchargeables et améliorées des normes disponibles. Le Guide aurait alors une valeur ajoutée pour les utilisateurs qui désireraient se procurer une copie, disponible localement, d'une ou plusieurs de ces normes. Le fait de fournir ces copies pourrait réduire l'utilisation du Guide, ce qui serait un inconvénient. Comme solution intermédiaire, on pourrait fournir des copies des normes mais en ajoutant à celles-ci une note faisant état des avantages à utiliser le Guide.

On a donné une description détaillée de la manière dont des « liens intelligents » vers plusieurs normes pourraient être conçus et mis en service. Cet exemple pourrait être étendu encore plus de manière à fournir un appui à d'autres mesure d'intégration avec le Guide HFE. De simples éléments sous forme de « cookies » sont déjà disponibles dans ce Guide. Ces « cookies » permettent de surveiller l'état du Guide pour l'utilisateur et de restaurer l'état préalable lorsqu'un utilisateur quitte le guide puis y revient.

Il faudrait envisager la possibilité d'utiliser des éléments d'appui plus perfectionnés. Par exemple, un logiciel appelé *LOCATE*, un outil de conception de l'espace de travail,

comporte actuellement des éléments permettant de rechercher des renseignements dans le Guide. Bien que ces éléments connaissent le Guide et permettent d'y faire des recherches, des éléments liés directement au Guide pourraient diffuser, à l'intention des éventuels utilisateurs, de l'information sur l'existence du Guide et sur son contenu.

Enfin, il serait utile de pouvoir imprimer certaines parties choisies des normes. Il faudrait envisager la possibilité d'imprimer des renseignements contextuels à ce contenu et d'autres renseignements connexes, selon les besoins ou selon les spécifications de l'utilisateur.

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Background

During the early 1990's, DRDC Toronto (formerly DCIEM) developed a series of hypertext software modules to provide access to available human engineering standards. Human Factors Engineering (HFE) Guides I, II, and III were developed to run on Macintosh computers. HFE-Guide I was developed for army applications, HFE-Guide II was aimed at all three elements and HFE-Guide III was based on design standards for the aircrew-machine interface.

In 1999, Artificial Intelligence Management and Development (AIM) Corporation submitted an unsolicited proposal to transfer HFE-Guide material from the Macintosh software to run on the world-wide-web (www) using Java software protocols to widen the availability of the material. That work was completed in March 2000.

Later that year it was decided that the www version of HFE-Guide should be incorporated into the web site for Human Systems Integration (HSI) run by Defence Research and Development Canada (DRDC), on both their DND Intranet and on their public Internet www sites. Additional development was undertaken to meet that goal.

The www version of HFE-Guide has been accessed and reviewed by human factors specialists in DND. The feedback has been mixed. Thus, it is necessary to respond to the users concerns and to improve the interface. As well it would be useful to update and expand the guidelines available to include naval human factors documents. The objectives and work items for this study were chosen with a view to enhancing the Guide and interface.

The purpose of this contract is to address the requirement of Defence R&D Canada Toronto (DRDC Toronto) to expand, update and enhance HFE-Guide tool by modifying existing material, adding new material and improving the interface to the Guide.

Research Approach

Study Objectives

The objectives of this contract are:

1. Review the concerns of users and, consistent with that review:
   - Add new standards for naval systems to HFE-Guide;
   - Update existing standards in the Guide;
   - Maintain a history of where the user has searched;
   - Link the results of a user's search to their location in standards;
   - Implement additional enhancements to the user interface.

Work Items

The following work items were undertaken:

1. Add New standards and upgrade existing standards in HFE-Guide.

a. Replace MIL-HDBK-46855 Material with MIL-HDBK-46855A
   i. convert text and add delimiters
   ii. extract figures and tables
   iii. establish cross-references
b. Replace MIL-STD-1472D with MIL-STD-1472F
   i. determine source file for standard
   ii. convert text and add delimiters
   iii. extract figures and tables
   iv. establish cross-references
c. Implement Six NATO Allied Naval Engineering Publications (ANEPS 20; 24-28)
   i. acquire best available copies
   ii. type documents
   iii. scan figures
   iv. add formulas
   v. cross reference figures

2. Maintain History When Selecting Cross-References

a. design history mechanism
b. include tracking and removal of circularity
c. implement history mechanism
d. modify cookies to accommodate new states

3. Identify Sources of Search Results

a. design for linking search results to standards & their locations
b. implement design for search results and bookmarks

4. Implement additional enhancements to user interface

a. review possible enhancements with scientific authority
b. based on results of discussion, design and implement solutions
c. make available for testing
d. implement any recommended changes

5. Demonstrate the additional functionality incorporated under the above work items.

6. Prepare a Final Report Detailing the Results of the Work Items Above.

Adding and Upgrading Standards in DRDC Toronto's Human Factors Engineering (HFE) Guide

This portion of the contract work focused on the addition of material to DRDC Toronto's HFE-Guide. Two major standards were upgraded with the most current versions and a set of naval standards were added to the Guide

Replacing MIL-HDBK-46855 with MIL-HDBK-46855A

This MIL-HDBK-46855A was available only in PDF format and so some work was required to extract the text and graphics, particularly the latter. Sections of the standard were converted from the PDF format and delimiters added as a way of indexing the material for referencing portions of the Guide.

Figures and tables were extracted and incorporated into separate Java windows, which are displayed by clicking on textual references within the Guide.

In addition to a table of contents for each standard and clickable access to the content associated with each of the references in the table, HFE-Guide provides a section with cross-references that allows users access to other related sections of the standard being explored. Figures and tables are among the items in the cross-references and, when clicked, are displayed in the separate Java windows as indicated above. This cross-reference capability is supported in MIL-HDBK-46855A.

Data Item Descriptions (DIDs)

Recent review and revision of Data Item Descriptions (DIDs) was conducted by the US DoD. Those in the series 80741 to 80747, included in the previous implementation of the Guide, have been replaced by Issue B; DID DI-HFAC-81XXX is now available as DID-HFAC-81399A. All of this new material was included as part of Appendix C in the MIL-HDBK-46855A document. Following earlier organisation of HFE-Guide, the DIDs were extracted from that Appendix and placed in a separate part of the Guide, accessible from the pop-up menu in the main window of the General Standards section.

HFE-Guide and PFD Document Formats

The principal reason for converting the 46855A Handbook material into the format used for HFE-Guide is the flexibility it provides. This can be contrasted with existing 46855A documents in PDF format.

As indicated, MIL-HDBK-46855A is available in PDF format but only in its entirety, that is, as a single document. The PDF format is more useful than hardcopy since it permits a table of contents and an index that can include clickable items. Such features allow users to navigate quickly to selected parts of a document. Also, the availability of a search facility makes finding items considerably easier than in corresponding hardcopy versions.

Although a table of contents and an index are available in currently implemented PDF versions of the MIL-HDBK-46855A, none were clickable, so that the user must navigate

manually to sections of interest. Further, no bookmarks were contained in those documents, which would provide a table of contents. Bookmarks do serve as a table of contents in a PDF document but that does not preclude having a clickable table of contents as part of the main document itself.

Again, the principal reason for converting the 46855A Handbook material into the format used in HFE-Guide is the flexibility it provides. That flexibility is illustrated in the Guide's tables of contents and in its bookmarking and searching capabilities. Unlike PDF-formatted documents, the material can be presented in focused ways that make it easy for users to address issues and answer questions that concern them. Further, when they return to the HFE-Guide site, say, the following day, the bookmarks, latest search results and tables of contents are as they were when they left them. This is achieved through the use of "cookies," which anonymously identify users by randomly assigned numbers and permit a restoration of the state of the Guide when the user last left it. Little or nothing comparable exists in PDF documents.

Another important advantage to the way in which standards are organised in the Guide is found in the presentation of cross-referenced material to users. Although that kind of cross-referencing can be found in PDF documents, it is often not used and indeed was not present in the PDF versions of 46855A found on the Internet. Further, the hypertext links in HFE-Guide can span different standards, if appropriate. This latter advantage is particularly appropriate for searches and bookmarked items that span more than one standard.

Replacing MIL-STD-1472D with MIL-STD-1472F

Both an HTML and a downloadable Word version of the 1472F standard were available as sources for an upgrade to HFE-Guide.

As part of a previous contract on HFE-Guide (W7711-0-7669), an MS Word version of this standard was downloaded and preliminary tests done to determine how easy it would be to convert that into HFE-Guide format. It was determined that most of the tagging of text could be automated. A sample of several images from the Word file revealed that they had been scanned at 300 dpi, certainly adequate for a 72 dpi screen display. Re-sampling of images from a higher resolution to 72 dpi is typically done for display on Internet sites. This decreases the time to load an image and reduces the amount of storage space required on the server.

A similar procedure to that of MIL-HDBK-46855A was used in the conversion of text, the addition of delimiters and extraction of figures and tables, with the exception that the extraction task was more straightforward when working with the MS Word file. Although part of the process of extracting and re-sampling images was automated for MIL-STD-1472F, some portions of the task had to be done manually.

Again, similar to the 46855A standard, the cross-references section was upgraded, allowing users to navigate to content related to the content currently displayed.

An advantage over the Guide's older MIL-STD-1472D material was that much of the tabular data in the sourced MS Word document was in text form. As a result, the contents of tables are now selectable and can be copied and pasted from the Guide. Tables in MIL-STD-1472D were images and none of the data in those tables were selectable. Selectable text in the tables of the Guide undoubtedly provides greater flexibility to its users.

As a future enhancement to HFE-Guide, it would be possible to create a PDF-formatted document of this standard, with clickable bookmarks, table of contents and index. Making such a document available to users would give added value to the Guide and to the simple HTML and MS Word versions available from other sites. This point is developed later in the report when discussing possible future enhancements to the Guide.

Implementing Six NATO Allied Naval Engineering Publications (ANEPS20; 24 - 28)

A review of a selected set of NATO Allied Engineering Publications (ANEPs) was conducted to determine the feasibility of adding them to HFE-Guide site. Of nine such documents, six were available. All were duplicate hardcopies of originals or, more likely, duplicates of duplicates, with consequent problems in readability. Attempts to locate electronic copies or hard copies of higher quality met with no success.

Despite the condition of the six ANEPs, they were thought to be of sufficient quality to proceed with creating electronic versions and adding them to HFE-Guide web site. Hardcopies of the following ANEPs were available:

- Human factors/ergonomics in the development and acquisition of ship weapon systems (ANEP 20)
- Guidelines for shipboard habitability requirements for combatant surface ships (ANEP 24)
- Guidelines for environmental factors in NATO surface ships (ANEP 25)
- Ergonomics data for shipboard space design in NATO surface ships (ANEP 26)
- Human factor guidelines for the design of man/machine interfaces in operational rooms (ANEP 27)
- Guidelines for the development of Operational Stations Book (OSB) for NATO naval vessels (ANEP 28)

Three ANEPs (ANEP 21-23) were not available and attempts to locate these were unsuccessful. If the following can be located in future, they should be incorporated into HFE-Guide:

- Procedure for ships manning for NATO surface ships (ANEP 21)
- Human factors considerations for the determination of automation policy (ANEP 22)
- The influence of maintenance on manning (ANEP 23)

The hardcopy documents that were available consisted of a combination of text, tables and figures with a few formulas scattered throughout. In almost all cases, the document text was clear enough to permit easy typing, however, the quality of some portions of the documents was a problem. Some of the figures were of such complexity and so reduced in size that some of the information in them was unreadable. Further, legends in the figures and tables, although readable for the most part, occasionally contained items that were not discernible.

In determining how best to handle the figures and tables, three types were identified: 1) those that could be typed or generated using a standard graphics package; 2) those that must be scanned; and, 3) those that contained some portion that must be scanned but permitted some text to be typed into the figure or table.

Sorting material in this way would allow for enhanced quality of the content of the documents that ultimately were to be included. In contrast, the simplest and most economical approach to reproducing figures and tables would be to scan them.

A decision was taken, in consultation with the Scientific Authority, to scan the majority of figures, creating only those that were clear enough and simple enough to permit easy reproduction.

Tables were more straightforward and it was decided to reproduce as many of them as possible as tables with selectable text for inclusion in the Guide. Captions were typed for both tables and figures. In the case of table and figure legends, a compromise was reached in which the figure was scanned and legend text was typed and added to the figure. As indicated however, in some cases portions of the legends themselves were not legible and had to be scanned.

The rule-of-thumb adopted in reproducing material from all of the ANEPs was that if an item could not be read, it would be scanned. This meant that while there was some sacrifice in legibility there was no danger of including material that might contain errors.

Other Enhancements to HFE-Guide

Identifying Sources of Search Results

A key problem with the results of user-initiated searches in the previous implementation of HFE-Guide was that the standard for the found information was not identified. That is, although the topic within a standard's table of contents was identified, it was not clear in which standard the topic was located. Correspondingly, no information was available as to where in the standard a particular search result could be found. These two related problems existed for bookmarked items as well.

To remedy this problem both for bookmarked and search results items, the Java windows for each were re-designed. In each case, an area about the size of a pop-up menu now identifies the standard where the currently selected search result or bookmarked item can be found. This area is located in the top left portion of the window, which is the same general area as the pop-up menu used for selecting the display of different standards in the main window of HFE-Guide.

Next, a new panel was added to the search results and bookmarked windows to provide more specific information about the location of selected items in the table of contents hierarchy for the associated standard. The information in that panel shows a direct ascent from the selected item to the top level in the table of contents for that standard.

In both the search results and bookmarked items windows, the information in the new "pop-up menu" and "location panel" are not selectable but are displayed solely for the purpose of providing the user with contextual information about those items. Contrast this with the actual pop-up menu and table of contents panel in the main Java window, where the former may be used to navigate to other standards and the latter to select topics within the standard, with associated content displayed in the contents panel.

Maintaining History When Selecting Cross-References

The problem here was similar in some respects to that described in the previous section, although more complex. Whereas search results and bookmarks are displayed in separate Java windows, cross-references are listed in a panel in both windows, as well as the main Java windows used to display the various standards. When a cross-reference list item is clicked, text is displayed in the contents panel of the window. If the cross-referenced item is a figure or table, it is displayed in a separate graphics window.

To make matters more complicated, cross-references can have their own cross-references, so that a user may navigate down several levels when pursuing cross-referenced material. Further, some cross-references may refer to items that have already appeared in previous cross-reference sections, one or more levels up. In practical terms, this means that a considerable number of cross-referenced items are circular, taking the user to sets of cross-references previously displayed.

That interface characteristic has been the cause of some confusion among users who do not realise that they are in a loop of circular sets of cross-referenced material. For the present contract, this was identified as a problem requiring re-deign. The solution to the problem now involves the Guide monitoring the presentation of cross-references for some given, entry-level content and removing duplicate items as the user "descends" into the sets of cross-references associated with that content.

In other words, as the user descends into one set of cross-references after another, previously displayed references are removed. In that way, the user sees only new cross-references and avoids an infinite loop of cross-referenced material. The solution removes the inherent redundancy in the Guide and eliminates an annoying source of confusion for the user.

Feedback: A User Interface Enhancement

The implementation of a facility to allow users of HFE-Guide to provide feedback about the many aspects of the Guide was identified as a key interface enhancement in the current contract. Such feedback addresses both the content material provided and the functional elements of the interface used in providing access to that information.

As a human factors site, such feedback exemplifies a built-in usability-testing and feedback mechanism, which can be used to improve the Guide for existing and future users.

The implementation of that feedback mechanism involved providing a "feedback" button visible in the currently active window just below the contents panel. Clicking on the button brings up a feedback window that provides optional name and email address, specification of a section for which the user is providing feedback (the current section is the default) and a place for feedback comments.

Pausing over the feedback button brings up a window with the following:

"HFE-Guide has been constructed with you in mind. Its goal is to provide you with quickest and easiest access to information you are seeking from a variety of human factors engineering standards.

Such a goal can never be fully realised but we value any suggestions you may have to help us get as close to that goal as possible.

No matter where you are in the Guide, when you click this button, a window will open to allow you to make whatever comments you would like to pass along. The Guide stores your comments and the location where you were in the Guide when you made those comments.

Thank you for helping us improve this Guide for you."

When a user provides feedback about some aspect of the Guide, that information is simultaneously stored on the server and sent to the Guide's developers. In that way, they are immediately made aware of possible problems users are experiencing with the Guide and any recommendations they might make for its improvement.

Names, Notes, Warnings and Disclaimers

Notes, warnings and disclaimers, added in the previous implementation of HFE-Guide, were updated. The name "Defence and Civil Institute of Environmental Medicine" and its associated acronym, "DCIEM" were changed to "Defence R&D Canada - Toronto" and "DRDC Toronto" in accordance with the new names recently given to Canada's Defence Research Laboratories.

The notes, warnings and disclaimers serve to qualify content throughout the Guide as well as individually for the various standards. On the main "Disclaimer" page, notes were added indicating that some older standards have been replaced with their current, updated versions. Warnings also appear pointing out areas in some of the standards where DRDC disagrees with the approach taken or the tests used.

A warning appears both on the main "Disclaimer" page and on the main page of the newly added Allied Naval Engineering Publications (ANEPs). That warning reads as follows:

> *"Hardcopies from which the ANEP Naval standards were typed and scanned were not always of good quality. Some of the text in the figures and tables were not completely legible. Scanning was done in all cases where there was some question about the content. Hopefully, in future, better quality copies can be acquired and changes made to improve the quality of the online material."*

Future Work

Future Materials and Facilities

Work in extending DRDC Toronto's HFE-Guide will involve upgrading current information in the Guide and adding new materials. One addition to the Guide that has been discussed is the Human Factors Engineering Data Guide for Evaluation (HEDGE), which is covered more thoroughly in the section on "intelligent" links to MIL-STD-1472F, below. Other candidate materials could involve a new standards or supporting documentation related to the currently implemented standards in the Guide or available on other human factors sites.

HFE-Guide site also might provide complementary, downloadable documentation to its existing standards as well as links to similar kinds of information residing on other sites.

HFE-Guide has been identified as a target search site for a system of agents implemented in a standalone application for workspace design called, *LOCATE*, also developed at DRDC Toronto. In aiding users in the use of *LOCATE*, the agent monitors their activity and, depending on the task they are performing, searches and retrieves information from HFE-Guide site that should help them address their design task more effectively.

New additions to HFE-Guide might look at ways to "publish" the material that resides there, e.g., an effective scheme that would make the material of more use to the *LOCATE* and similar agents seeking human factors knowledge for different purposes. Another approach might be to use mobile agents to share information about the existence and content of HFE-Guide with servers and possibly other software agents.

Enhancing HFE-Guide with PDF-Formatted Documents

DRDC Toronto should consider re-saving standards in PDF-formatted documents and providing "bookmarks," a table of contents and an index, all of which would contain clickable items. This would enhance the HFE-Guide site by offering added value to those users who would like to have access to downloadable PDF versions of current standards. None of the existing standards available on the Internet appear to have these more extensive facilities in their PDF versions.

Adding those facilities to PDF-formatted documents would require a modest time commitment for each standard, likely well worth the advantage to those interested in having their own personal copies. Of course, issues related to standards distribution and a desire to encourage the use of HFE-Guide site would need to be considered. Making HFE-Guide site the source for the best available copies of downloadable standards would go a long way to attracting people to the site and encouraging users to return.

The Context for Figures and Cross-Referenced Material

A separate panel is provided for listing figures and cross-references associated with the content being displayed in the contents panel of the Java windows. Unfortunately, selecting an item in that panel often produces new contents which themselves have figures and cross-references. Thus, when a selection is made, new content appears in the contents panel and any figures and cross-references associated with that new content take the place of the figures and cross-references that were there.

Although the user can navigate back to the previous content which displays the original cross-references and figures, during the time the user is navigating through increasingly deeper sets of figures and cross-references, each previous set is temporarily lost from view.

In earlier implementations of the Guide, this problem was compounded by the fact that some figures and cross-references contained links to ones the user had already seen and so the user could find himself in an infinite loop of figures and cross-references. That problem was solved in the current implementation in which the Guide tracks items that have already been displayed and prevents their subsequent display. Although this has helped to reduce an important problem, it has not solved the problem of the "disappearing" figures and cross-references.

An associated problem is that the user may not know when she is at the top level after pursuing figures and cross-references to some depth. A solution that could help solve that problem would be to update the table of contents panels to reflect the location of the currently selected cross-reference and, similar to items in the new "Location in Standard" panels in the Search and Bookmarks windows, make the updated table of contents non-selectable.

In that way, the user would always know if he were looking at content associated with cross-references or were back at the top level of the table of contents, that is, at the level at which the original figures and cross-references are displayed and items in the table of contents are selectable.

To make the distinction even more explicit for the user, navigation buttons could appear whenever a cross-referenced item is selected. Titles for those buttons might read, "Up One Level" and "Top Level," indicating that the user could navigate back up one level at a time in the cross-referenced material or go immediately to the top level and to the selectable table of contents. Another button, similar to one that appears in PDF readers, could be included that would let the user return to the last cross-referenced section. In that way it would be possible to go to the top of the cross-references and then return immediately to a prior location that might be several levels down in the figures and cross-references.

More effective monitoring of cross-referenced items and identification of their location would make using this aspect of the Guide more useful.

Making References Selectable

Modifying HFE-Guide to provide clickable items in the contents panel would result in the presentation of referenced material in a new window much as is currently done for figures and tables.

The advantage would be the possible elimination of the "Figures and cross-references" panel and the consequent freeing up of additional real estate in the Java windows. It is not clear, however, whether having items accessible in the contents panel would be more desirable than having them visible and selectable in the figures and cross-references panel while the user scrolls through those contents, as is presently the case.

In principle, there is no reason making items in the contents panel clickable cannot be done. The challenge will be identifying all the references in the old HyperCard versions (there was never a version that combined the content for all of the HyperCard stacks into one complete application) and specifying them in the Java-based HFE-Guide.

The procedure for setting up clickable references in the content area of the Guide would require a modest time commitment. What will require considerably more time is identifying all instances, across all the old HyperCard stacks, in which a clickable reference occurs and incorporating those instances into the Guide. Further, those would have to be checked against the list of figures and cross-references in that panel to determine whether there is any need for the references in the panel, and consequently for the panel itself.

If clickable references in the text of the contents panel effectively eliminated the need for a separate figures and cross-referenced panel, it might be possible to treat those references in a similar way to how they are treated in HTML views, that is, clicking would take the user to a different position in the current contents panel or display a new set of contents entirely. Forward and backward buttons would operate much as they do in the typical Internet browser. The added screen real estate might be enough to avoid displaying figures in a different window. Larger views of figures could be accommodated if the user wanted a more detailed view. What would be lost is the ability to see the list of cross-references and figures while viewing any portion of the contents with which they are associated.

One thing that might prevent this more flexible adaptation, which would make the interface of HFE-Guide more consistent with the interface of Internet browsers, would be if some items in the figures and cross-references panel actually do not appear in the text of the contents window.

"Intelligent Links" for Task Analysis and Design Guide Material

This task was identified in a previous study and is worth repeating here. It relates to the first sub-section of the "Future Work" section, which deals with the addition and modification of material to HFE-Guide. It is largely an exercise in compiling, organising and cross-referencing material, some of which already exists in HFE-Guide. Information would be combined from several sources:

- the HFE Design Guide for Evaluation Linked to Functions, Tasks and Conditions of Use, referred to on HFE-Guide site as, "Task Info," and which is the **task checklist portion** of the Human Factors Engineering Data Guide for Evaluation (HEDGE) (TOP-1-2-610);
- the **design checklist portion** of the Human Factors Engineering Data Guide for Evaluation (HEDGE) (TOP-1-2-610).
- the Design Criteria for Military Systems, Equipment and Facilities (MIL-STD-1472F);
- Cold Regions Data, for which no documentation currently is available to us;
- Guidance Data (MIL-HDBK-759, etc.), for which at least some documentation is available.

The task is a challenging one for several reasons. First, although a recent discovery yielded a much more legible document for some of the material, other documentation contains text that is quite small, in some cases illegible, and for which better copies may or may not be available.

Second, no documentation is available to date on the Cold Regions Data, nor is it clear, given the print quality of the documentation, how extensive those references are. Further, it does not appear that this material is included in the more recent release of the HEDGE document.

Next, from an examination of entries in a recent version of the HEDGE document, it is clear that some references are retained to the Guidance Data, specifically, MIL-HDBK-759. This is complicated slightly by the fact that a newer version of this standard is available, namely, MIL-HDBK-759A (MI).

At the end of the original HEDGE document, there are many references to other standards. Those appear in a section at the end of the document that contains many figures. The referenced standards are listed on the figures themselves and include the following:

- BUMEDINST 62606
- MIL-A-8806
- MIL-M-18012
- MIL-STD-1333
- MIL-STD-1474
- MIL-STD-250
- MIL-STD-740
- NATICK/TK-77/024
- BUSHIPS-SPEC-1-10
- MIL-C-25050
- MIL-STD-1247
- MIL-STD-1472
- MIL-STD-203
- MIL-STD-411
- MIL-STD-759
- SAE J925

In the more recent HEDGE document, many of those figures do not appear but references to some of the standards are made throughout the documentation. Those references are not as extensive as in the earlier HEDGE.

Lastly, the more recent version of HEDGE, while being more current and legible, does not contain the matrices included in the original version. As such, there are no associated content matrices like there are in the earlier document.

Given the above issues, a key question is whether it is possible to proceed to design and implement something from all these materials that would be of use to users of HFE-Guide. The answer to that question undoubtedly is "Yes," as the following comments make clear:

> Given that most references in both versions of HEDGE are to the 1472 standard, likely the best course in approaching what to include would be to use the more recent version of HEDGE with its clear references to the cited items in the 1472 standard.
>
> That version contains references to the 1472D standard and some of those references will have been extended or refined in the new 1472F version. The recommended approach would be to use the HEDGE references to 1472D and then check those against the newer 1472F standard, now incorporated into the Guide.
>
> Although the more recent version of HEDGE does not contain the extensive matrices of cross-referenced material found in the original version, it does contain information that would allow similar matrices to be inferred. Inference, along with the models from the earlier version, would allow the creation of new matrices for incorporation into the Guide.
>
> One variation is that a new category, "Functionality," has been added to the categories of "Human Factors Considerations" that appear in the matrices. It appears, however, that this category does not contain new information but simply represents a new way of breaking out the information in the older HEDGE content matrices. It should not be difficult to accommodate this change and the associated content when creating the new matrices.

A Print Function for Items in the Guide's Java Windows

One of the options that DRDC Toronto likely will want to provide to users of HFE-Guide in future implementations is the printing of text, tables and figures. Figures in the Guide have been re-sampled at a resolution of 72 dpi, which is the maximum quality on a normal screen display. This resolution level, while fine for text and tables, is often not adequate for figures.

In future, figures could be provided for printing at a higher resolution. In preparation for that possibility, the figures from the six ANEPs implemented as part of the current contract were scanned at 1200 dpi. In future versions of the Guide, those and other higher resolution figures could be provided to users for printing. Although this would mean higher storage requirements on the server, it would be a good strategy to provide high quality figures for printing while at the same time maintaining efficiency in their display.

There is extensive support in Java to render pages for printing through the Java printing model and associated API. Using the model and the API, however, is not a simple task and will require time to develop the appropriate mechanisms to provide users of HFE-Guide with an ability to print items contained in the Java Windows.

Feedback

A simply extension to the newly implemented feedback mechanism that likely would find favour with users would be an automated email messaging system, which would send a "Thank you" message as a follow-up to any feedback provided. More sophisticated implementations could determine whether a user had provided previous feedback and customise the "Thank you" based on that knowledge.

Such a mechanism would be a logical extension of a currently implemented mechanism that takes the current feedback and sends it as email to developers of the Guide.

Other Guide Enhancements

Future enhancements could take advantage of the Guide's cross-referencing ability by allowing users to open multiple windows on information they might wish to compare, view a history of their navigation among content pages and cross-references, save sets of bookmarks associated with different purposes for which they had accessed the Guide, store lists of search results under different names and associate histories, bookmarks and search results together.

All of the suggestions in this section are just a few ideas for how HFE-Guide might be extended, given its current organisation. It again should be noted that few if any of these would be possible working with standalone documents such as a Word or PDF-formatted document.

Annex 1

Annotated List of HFE-Guide Source Code Files

CGI Source Files

GetSection.c

- This file contains the C code for the CGI that retrieves a specified section of HFE-Guide from the server.

GetUser.c

- This file contains the C code for the CGI that retrieves the user settings from the server.

Search.c

- This file contains the C code for the CGI that searches HFE-Guide text on the server.

SendUser.c

- This file contains the C code for the CGI that stores the user settings on the server.

Java Source Files

HFEGuide.java

- This file contains the Java code for HFE-Guide interface.

HFEGuide.mcp

- This is the Metrowerks CodeWarrior project file for HFE-Guide.

Server files

AirStan.html

- This file contains the HTML code for the Air Standards page.

ArrowBullet.gif

- This image is referenced by the "HFEIntro_Page.html" file.

GenStan.html

- This file contains the HTML code for the General Standards page.

GetSection.cgi

- This file contains the executable CGI that retrieves the user settings from the server.

GetUser.cgi

- This file contains the executable CGI that retrieves a specified section of HFE-Guide from the server.

Graphics

- This folder contains all of the image files for the figures and tables.

HFE_Background.gif

- This image is referenced by the "HFE_IntroPage.html" file.

HFE_IntroPage.html

- This file contains the HTML code for HFE-Guide Intro page.

HFE Title.gif

- This image is referenced by the "HFEIntro_Page.html" file.

HFEData

- This file contains all of HFE-Guide text.

Java Classes

- This folder contains all of the Java class files for HFE-Guide.

Lookup

- This file contains a look-up table which allows HFE-Guide to find the title of a section given its ID.

Outline1

- This file contains the table of contents information for the "Air Standards - By Topic" section.

Outline2

- This file contains the table of contents information for the "Air Standards - By Series" section.

Outline3

- This file contains the table of contents information for the "MIL-STD-1472 Section 5" section.

Outline4

This file contains the table of contents information for the "MIL-STD-1472 Except Section 5" section.

Outline5

- This file contains the table of contents information for the "MIL-STD-1472 Figures and Tables" section.

Outline6

- This file contains the table of contents information for the "MIL-STD-46855" section.

Outline7

- This file contains the table of contents information for the "Data Item Descriptions (DIDs)" section.

Outline8

- This file contains the table of contents information for "Task Analysis Info" section.

Outline9

- This file contains the table of contents information for the "Test Methods" section.

Outline10

- This file contains the table of contents information for the "DID Tutorial" section.

OutlineHelp

- This file contains the table of contents information for the "Help" section.

OutlineGlossary

- This file contains the table of contents information for the "Glossary" section.

RD_DCIEM.gif

- This image is referenced by the "HFE_IntroPage.html" file.

Search.cgi

- This file contains the executable CGI that searches HFE-Guide text on the server.

SendUser.cgi

- This file contains the executable CGI that stores the user settings on the server.

DOCUMENT CONTROL DATA SHEET		
1a. PERFORMING AGENCY Artificial Intelligence Management and Development Corporation, 206 Keewatin Avenue, Toronto, ON M4P 1Z8 CANADA		2. SECURITY CLASSIFICATION UNCLASSIFIED - Unlimited distribution -
1b. PUBLISHING AGENCY DRDC Toronto		
3. TITLE (U) Enhancements to DRDC Toronto's HFE-Guide For The World-Wide Web		
4. AUTHORS Jack L. Edwards		
5. DATE OF PUBLICATION July 31 , 2002		6. NO. OF PAGES 35
7. DESCRIPTIVE NOTES		
8. SPONSORSHIP/MONITORING/CONTRACTING/ASKING AGENCY Sponsoring Agency: Monitoring Agency: Contracting Agency: DRDC Toronto Tasking Agency:		
9. ORIGINATOR'S DOCUMENT NO. Contract Report CR 2002-121	10. CONTRACT, GRANT AND/OR PROJECT NO. PWGSC W7711-01-7756/001/TOR	11. OTHER DOCUMENT NOS. AC227
12. DOCUMENT RELEASABILITY Unlimited announcement		
13. DOCUMENT ANNOUNCEMENT Unlimited announcement		

14. ABSTRACT

Two key standards of HFE-Guide (MIL-HDBK-46855; MIL-STD-1472) were upgraded. Data Item Descriptions (DIDs), Issue B, taken from an Annex in MIL-HDBK-46855A, replaced earlier versions of DIDs. Six Allied Naval Engineering Publications (ANEPs) were typed and scanned from hardcopies and then added as a new section of HFE-Guide.

The locations of search results are now identified, including both the standard in which the result is found and its location within that standard. A newly designed history mechanism now keeps track of cross references so as to avoid repeated presentations, which formerly "trapped" users in infinitely repeating cycles. Another addition allows users to provide feedback about any aspect of the Guide at any point during a session. Notes, warnings and disclaimers were updated and instances of the name, "Defence and Civil Institute of Environmental Medicine (DCIEM)" were changed to reflect recent changes in the names of Canada's Defence Research Laboratories.

Possible future work includes the addition of new standards and materials, the creation of a broader context for cross-referenced material, selectable references within the content windows, provisions for downloadable and enhanced PDF versions of the standards, intelligent links among various standards and the ability to print portions of the standards material.

RÉSUMÉ

Deux normes clés du Guide HFE (MIL-HDBK-46855 et MIL-STD-1472) ont été mises à jour. Des descriptions d'éléments de données (DED), version B, provenant d'une Annexe de MIL-HDBK-46855A, remplacent des versions précédentes de DED. Six publications interalliées sur l'ingénierie navale (ANEP) ont été dactylographiées. Elles ont ensuite été numérisées à partir de la copie papier, puis insérées dans le Guide HFE dans lequel elles constituent une nouvelle section.

Les résultats des recherches sont désormais référencés. La norme dans laquelle le résultat a été trouvé ainsi que leparagraphe en question de cette norme sont indiqués. Un mécanisme nouvellement conçu permet de recouper les références, afin d'éviter les répétitions qui, jusqu'alors, piégeaient les utilisateurs dans des cycles répétitifs sans fin. Un nouveau système permet aux utilisateurs de faire des commentaires sur n'importe quel aspect du Guide, à tout moment au cours d'une séance de recherche. Les remarques, les avertissements et les clauses de non-responsabilité ont été mis à jour et les occurrences de l'entité « Institut de médecine environnementale pour la défense (IMED) » ont été remplacées afin de refléter les récentes modifications apportées aux noms des Laboratoires de recherches pour la défenses du Canada.

Parmi les travaux qui pourraient être réalisés, on compte : addition de nouvelles normes et de nouveau matériel; création d'un champ plus vaste de matériel référencé; références pouvant être sélectionnées à partir des fenêtres de contenu; possibilité d'accès à des versions téléchargeables des normes en format PDF amélioré; liens intelligents entre diverses normes; et capacité d'imprimer une partie du contenu des normes.

15. KEYWORDS, DESCRIPTORS OR IDENTIFIERS

(U) HUMAN ENGINEERING TOOLS; HUMAN FACTORS ENGINEERING; HFE GUIDE; GENERAL STANDARDS; NAVAL STANDARDS; AIR STANDARDS; U.S. MIL-STD-1472F; U.S. MIL-HDBK-46855A; DATA ITEM DESCRIPTIONS; TEST PROCEDURES AND MEASUREMENT METHODS; ALLIED NAVAL ENGINEERING PUBLICATIONS; ANEP; NATO STANAGS; AIR STANDARDISATION COORDINATING COMMITTEE STANDARDS.

DESIGN GUIDE; FUNCTIONS; TASKS; CONDITIONS OF USE.